(12) INNOVATION PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 2003100060 A4

(54) Title
Light curing unit

(51)7 International Patent Classification(s)
A61C 013/15

(21) Application No: **2003100060** (22) Date of Filing: **2003.01.31**

(45) Publication Date: **2003.07.03**
(45) Publication Journal Date: **2003.07.03**
(45) Granted Journal Date: **2003.07.03**

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ABSTRACT

This invention concerns a light curing unit. The unit includes a light source enclosed within a housing, a light guide having a first end optically engaged to the housing and a second end, and a light guide applicator optically engaged to the second end of the light guide and having a surface for positioning adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth. The arrangement is such that in use, when light is transmitted through the light guide and to the light guide applicator, the light transmits through the surface of the light guide applicator which in use is positioned adjacent to the plurality of mounted brackets to cure the adhesive and bond each bracket to its' respective tooth. The invention further concerns a combination of a light guide and a light guide applicator, and a method of using a light curing unit to bond a plurality of adhesively mounted brackets to a plurality of respective teeth. The invention further concerns a light guide applicator.

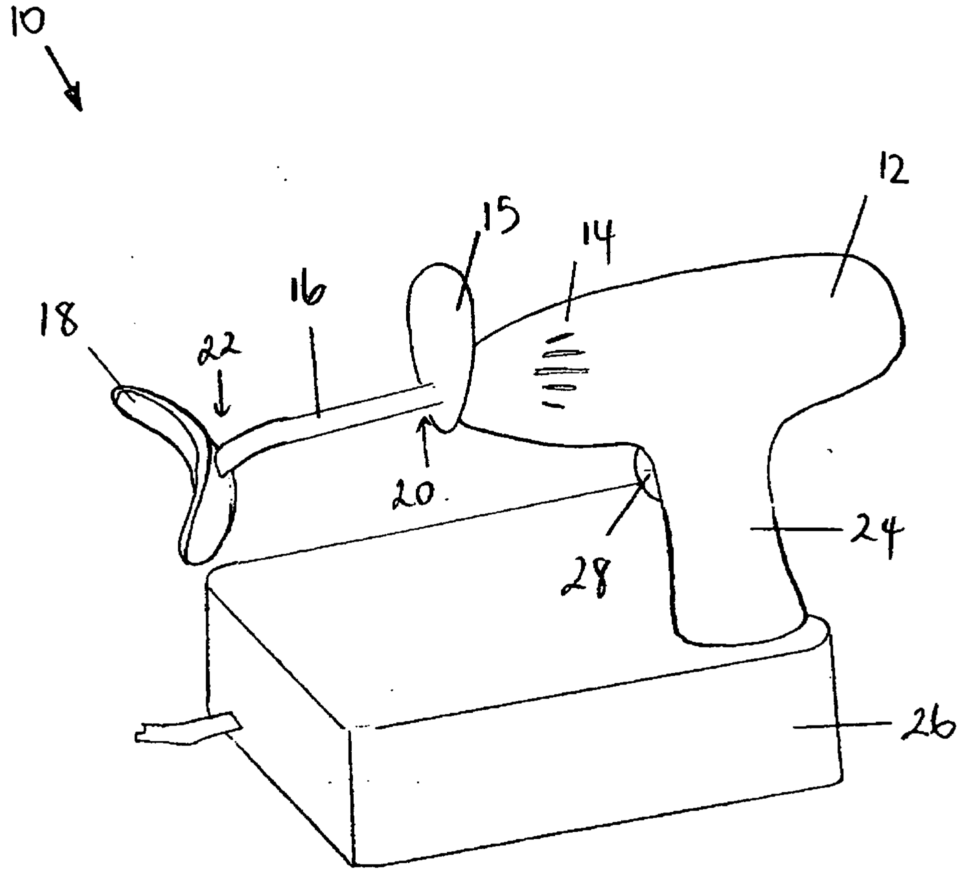

Fig. 1

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COMPLETE SPECIFICATION
INNOVATION PATENT

Invention Title:

Light Curing Unit

The following statement is a full description of this invention including the best method of performing it known to us:-

Technical Field

The present invention relates to a light curing unit. The invention further relates to a combination of a light guide and light guide applicator. Furthermore, the invention relates to a light guide applicator. Additionally, the invention relates to a method of using a light curing unit to bond a plurality of adhesively mounted brackets to a plurality of respective teeth.

Background Art

Orthodontic treatment involves the movement of irregularly arranged teeth to regular positions. In certain treatments, a bracket is arranged on a patient's tooth by means of a light activated resin. Devices known as light curing units are used to cure the resin and bond the bracket to the tooth. Such a unit typically consists of a light source mounted in a housing and a light guide to deliver the transmitted light to a bracket.

The wavelength of the source of light available for the range of light activated resins is between 400 nm and 500 nm. A commonly used light source is quartz-tungsten-halogen. Whilst quartz-tungsten- halogen technology has a broad spectrum coverage, curing takes about 20 to 30 seconds per bracket or a total of about 10 minutes for the complete upper and lower arch of a patient.

Newer generation light sources utilise plasma technology as the light source. Use of the plasma arc considerably reduces curing time. Typically curing takes on average 3 seconds per bracket or a total of about 84 seconds for the complete upper and lower arch of a patient. However use of plasma technology is expensive.

Disclosure of Invention

In a first aspect, the invention is a light curing unit comprising:

a light source enclosed within a housing;

a light guide having a first end optically engaged to the housing and a second end; and

a light guide applicator optically engaged to the second end of the light guide and having a surface for positioning adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth;

the arrangement being such that in use, when light is transmitted through the light guide and to the light guide applicator, the light transmits through the surface of the light guide applicator which in use is positioned adjacent to the plurality of mounted brackets to cure the adhesive and bond each bracket to its' respective tooth.

In a second aspect, the invention is a combination of a light guide and a light guide applicator, the combination comprising:

a light guide applicator having a surface for positioning adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth; and

a light guide having a first end, and a second end optically engaged to the light guide applicator;

such that in use, when the first end of the light guide is optically engaged to a light source, light is transmitted through the light guide to the light guide applicator and through the surface of the light guide applicator which in use is positioned adjacent to the plurality of mounted brackets to cure the adhesive to bond each bracket to its' respective tooth.

In a third aspect, the invention is a light guide applicator shaped to conform to a plurality of a patients' teeth, such that in use, when a surface of the light guide applicator is positioned adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth, and when a light guide optically engages with the light guide applicator to transmit light through the light guide, light transmits through the surface of the light guide applicator to cure the adhesive to bond each bracket to its' respective tooth.

The light guide may be made from a metal, plastic, ceramic, or other like material. The light guide applicator may be made from the same material as the light guide.

The optical engagement of the light guide to the housing may be fixed or may be detachable to accommodate light guides of differing configurations. A plug may enclose the first end of the light guide, and the plug may be inserted into the housing so as to provide an optical engagement with the light guide. The optical engagement may be such to produce an effective flux coupling so as to get the light from the source into the light guide with minimal loss. The first end of the light guide may have a radiation pattern to match the configuration of the light source to maximise the flux coupling.

The optical engagement of the second end of the light guide to the light guide applicator may be fixed or may be detachable to accommodate different configurations of the applicator and/or light guide. For this reason, an adaptor may be provided to fit the light guide applicator to the second end of the light guide. The optical engagement may be such so as to allow the light to pass into the light guide applicator with minimal loss.

The light guide applicator may be manufactured in different shapes and sizes, for example, the applicator may approximately form to the shape of the arch of a child's jaw, a young adult's jaw, or an adults jaw, so as to conform to all of the teeth in the upper or lower arch of a patients jaw. Different shapes may be required depending on whether the brackets are mounted to the anterior surfaces or the posterior surfaces or the lingual surfaces of a patients teeth.

For an embodiment where lingual brackets are required, a further adaptor may be necessary to facilitate the positioning of the light guide applicator in the mouth of a patient. This adaptor may be positioned between and in optical engagement with the second end of the light guide and the light guide applicator. Alternatively, the light guide may be flexible. Short light guide applicators may be designed to cure two or more brackets.

The light guide applicator may have an indent for the engagement of the second end of the light guide. The indent may penetrate through a surface of the applicator remote from the surface adjacent to the mounted brackets and may be located centrally along the remote surface of the applicator. The remote surface may be a thin layer made from a material having different properties than the remainder of the light guide applicator. The remote surface, which the light guide engages with, may be made from a material, which is impermeable to the passage of light, or may be coated with a light reflecting paint. The shape of the remote surface may assist in the reflection of the light.

The light curing unit may further comprise an eye shield detachably mounted with the light guide.

In a fourth aspect, the invention is a method of using a light curing unit to bond a plurality of adhesively mounted brackets to a plurality of respective teeth, the method comprising the steps of:

applying a bonding agent to a prepared surface of a plurality of teeth for the mounting of a bracket;

placing a spot of light curing adhesive on the base of each bracket;

placing a bracket onto each prepared surface of a tooth ;

positioning a light guide applicator adjacent to each mounted bracket; and transmitting light into the light guide applicator such that the light transmits through a surface of the light guide applicator positioned adjacent to the mounted brackets to simultaneously cure the adhesive spots and bond each bracket to its' respective tooth.

In order to prepare the teeth prior to placement of a bracket, each surface must be pumiced, washed and dried. The tooth surfaces are then etched, before being washed and dried for a second time. The bonding agent is then painted onto the prepared surfaces of the teeth.

In an alternative, a plaster cast of an arch of a jaw of a patient may be pre-prepared and each bracket may be custom placed on each tooth of the plaster cast. A rubber based impression material is then placed over and around the brackets. After the impression material is set, a vacuum formed cover is placed over the material and operated to remove the plaster cast. The result is a custom designed tray with the brackets pre-positioned ready for placement of the adhesive and bonding to the prepared teeth simultaneously. The tray is then fitted to the teeth, and the light guide applicator could then be used to simultaneously cure all the brackets.

An advantage of at least one embodiment of the invention is that the length of time taken to cure the adhesive in order to bond the brackets to the teeth is reduced. This improves the efficiency of an operator's practice and reduces inconvenience to the patient.

Brief Description of Drawings

An embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a diagram of a light curing unit; and

Figure 2 is a perspective view of the light guide and the light guide applicator as illustrated in figure 1.

Best Mode for Carrying Out the Invention

Figure 1 illustrates a light curing unit 10. The unit 10 includes a housing in the form of a curing gun 12, light guide 16 and light guide applicator 18. A light source (not shown) in the form of a halogen lamp is contained within the gun 12. The gun 12 can be accessed by way of a flap to change the halogen lamp. Ventilation slits 14 surround the nose of the gun 12. A fan (not shown) is also enclosed in the gun to assist in the circulation of air. The gun 12 also contains light filters. The halogen lamp generates white light and the filters filter the white light so that only light in the 400 to 500 nm range is transmitted through the light guide 16. The handle 24 of the gun 12 contains a rechargeable battery. The unit 10 is mounted in a stand 26, which is connected to a power supply (not shown) to charge the battery.

The light guide 16 is a standard 8-mm autoclavable guide. However, other methods of sterilising the guide may be performed depending on the facilities. The sides of the light guide 16 parallel to the direction of light, are smooth and coated with a light reflecting paint. This assists in directing those rays that have an angle less than the critical angle. The first end 20 of the light guide 16 is surrounded by a plug, which detachably and optically engages with an output port situated on the nose of the gun 12. A protective eye shield 15 is mounted to the first end 20 of the light guide 16.

As illustrated in figure 2, the second end 22 of the light guide 16 detachably, and optically engages with the light guide applicator 18 by way of an indent (not shown). The indent has a ridge in which the light guide 16 turns, to lock into a stable position with the light guide applicator 18. The size of the applicator 18 depends on the size of the jaw of the patient. For an adult, or young adult, the applicator has a length of about ten cm, a width of about four mm and a 16 mm depth anteriorly, tapering to 13mm posteriorly. The applicator 18 in this embodiment is shaped to conform to the upper arch of a patients' teeth and is designed for use where the brackets are mounted to either one or both of the anterior surfaces and the posterior surfaces of the patient's teeth. The optical coupling of the light guide 16 and the applicator 18 minimises the loss of intensity of the light as it passes through the guide 16 and into the applicator 18. The material from which light guide applicator 18 is made is the same as the light guide 16. As with the light guide 16, the side surface 23 and rear surface 19 of the applicator 18 are coated with a light reflecting paint to assist in guiding the light towards the front surface 21 of the applicator, and to minimise the reduction in the intensity of the light as its travels through the applicator 18.

Before operation, a bonding agent is painted onto the anterior and posterior surfaces of each of a patients teeth for placement of the brackets. A spot of a light curing adhesive is applied to the surface of each bracket. The adhesive contains a photoinitiator molecule (camphoroquinone) and an amine activator. The inner surface of each bracket is mounted onto the anterior and posterior surfaces of each of the teeth respectively.

The applicator 18 is positioned so that the surface 21 is adjacent to the outer surface of each bracket which is mounted on the anterior surface of the teeth. The gun with the light guide 16 pre-connected is fitted with the applicator 18. The light guide 16 is slightly rotated to form a locking engagement with the applicator 18. The operational button 28 is depressed for a sufficient period of time to cure the adhesive and to simultaneously bond each bracket to its' respective tooth. When the adhesive is exposed to the light, the photoinitiator becomes excited and reacts with the amine to produce the free radicals, thereby initiating the polymerisation process.

Although one embodiment of the invention has been discussed, it should be appreciated that such an embodiment is only one of the many utilising the principles of the present invention. In alternative embodiments, the light source may be a plasma arc and the light source may be tuned to transmit light having a wavelength in the range of 400 nm and 500 nm. In an optional embodiment the light source may be an light emitting diode. The means to energise the light source may be remote from the gun and may be powered by the mains. The light guide may be an optical grade material such as acrylic resin, polycarbonate, epoxy, or glass. In alternate embodiments the light guide may be a rigid glass rod, or flexible by way of a fibre-optics cable, or a cable for liquid transmission.

To assist in the transmission of light from the light guide to the applicator, a system of mirrors may be incorporated.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A light curing unit comprising:

a light source enclosed within a housing;

a light guide having a first end optically engaged to the housing and a second end; and

a light guide applicator optically engaged to the second end of the light guide and having a surface for positioning adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth;

the arrangement being such that in use, when light is transmitted through the light guide and to the light guide applicator, the light transmits through the surface of the light guide applicator which in use is positioned adjacent to the plurality of mounted brackets to cure the adhesive and bond each bracket to its' respective tooth.

2. A combination of a light guide and a light guide applicator, the combination comprising:

a light guide applicator having a surface for positioning adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth; and

a light guide having a first end, and a second end optically engaged to the light guide applicator;

such that in use, when the first end of the light guide is optically engaged to a light source, light is transmitted through the light guide to the light guide applicator and through the surface of the light guide applicator which in use is positioned adjacent to the plurality of mounted brackets to cure the adhesive to bond each bracket to its' respective tooth.

3. A light guide applicator shaped to conform to a plurality of a patients' teeth, such that in use, when a surface of the light guide applicator is positioned adjacent to a plurality of orthodontic brackets adhesively mounted to a plurality of respective teeth, and when a light guide optically engages with the light guide applicator to transmit light through the light guide, light transmits through the surface of the light guide applicator to cure the adhesive to bond each bracket to its' respective tooth.

4. A method of using a light curing unit to bond a plurality of adhesively mounted brackets to a plurality of respective teeth, the method comprising the steps of:

applying a bonding agent to a prepared surface of a plurality of teeth for the mounting of a bracket;

placing a spot of light curing adhesive on the base of each bracket;

placing a bracket onto each prepared surface of a tooth;

positioning a light guide applicator adjacent to each mounted bracket; and

transmitting light into the light guide applicator such that the light transmits through a surface of the light guide applicator positioned adjacent to the mounted brackets to simultaneously cure the adhesive spots and bond each bracket to its' respective tooth.

5. A light curing unit substantially as herein described with reference to the accompanying drawing.

Dated this thirty first day of January 2003

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Patent Attorneys for the Applicant:

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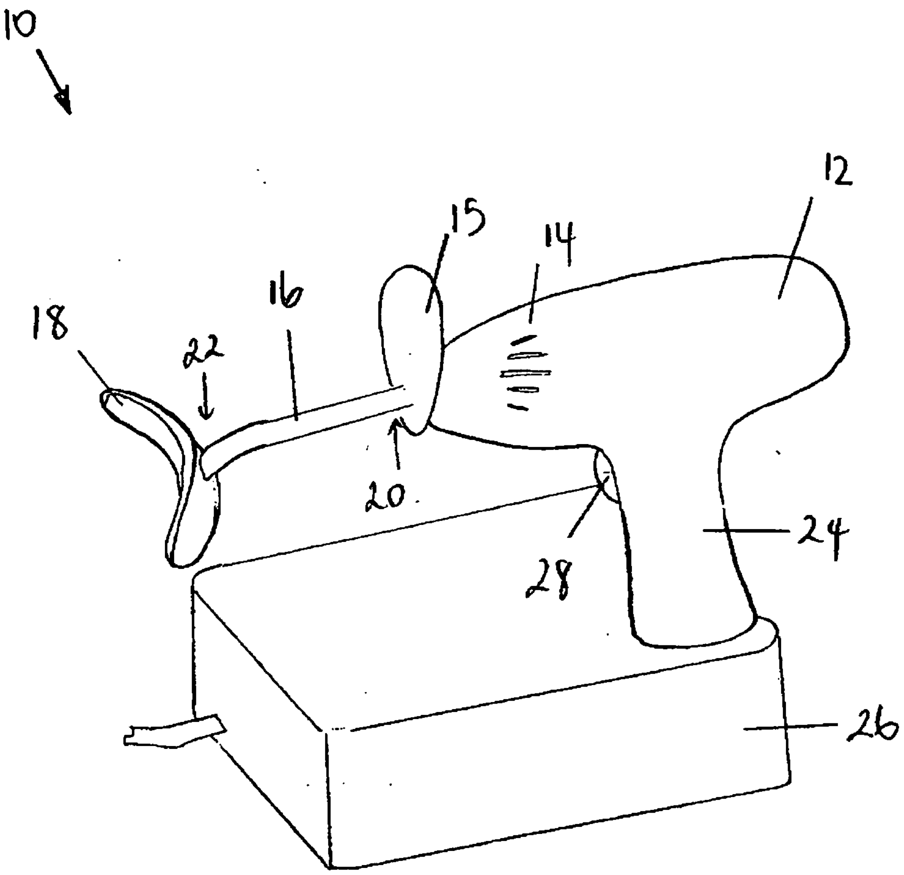

Fig. 1

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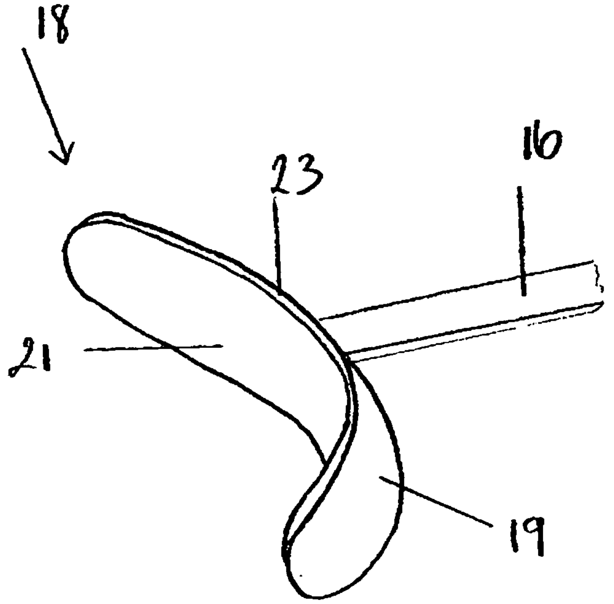

Fig. 2

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